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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/025,913	12/26/2001	Nam-Kyeong Kim	P67350US0	7589

7590 12/03/2003

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EXAMINER

NGUYEN, KHIEM D

ART UNIT PAPER NUMBER

2823

DATE MAILED: 12/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/025,913

Applicant(s)

KIM ET AL.

Examiner

Khiem D Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 September 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-4 and 6-17 is/are pending in the application.
- 4a) Of the above claim(s) 14-17 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 6-13 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Response to Arguments*

Applicant's arguments with respect to claims 1-4 and 6-13 have been considered but are moot in view of the new ground(s) of rejection.

### *New Grounds of Rejection*

#### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4 and 6-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over the applicant's admitted prior art of this application (AAPA) in view of Kirlin et al. (U.S. Patent 6,320,213), Noh (European Patent Application EP 1 035 590), and Narwankar et al. (U.S. Pub. 2001/0043453).

In re claim 1, AAPA discloses a method for manufacturing a semiconductor device, comprising the steps of (See Description of the Prior Art on pages 1-3 and **FIG. 1** of this application):

providing a semiconductor substrate (**FIG. 1: 10**);

forming an interlayer insulating layer (**FIG. 1: 11**) on the semiconductor substrate;

forming a contact hole in the interlayer insulating layer (page 2, lines 12-16 and **FIG. 1**);

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forming a plug (**FIG. 1: 12**) recesses inside the contact hole;  
forming an ohmic contact layer (**FIG. 1: 13**) on the plug;  
depositing a layer of TiN diffusion barrier layer (**FIG. 1: 14**) on the ohmic contact layer; and

sequentially forming a bottom electrode (**FIG. 1: 15**), a BLT ( $\text{Bi}_x\text{La}_y$ ) $\text{Ti}_3\text{O}_{12}$  dielectric layer (**FIG. 1: 16**) and a top electrode (**FIG. 1: 17**) on the entire structure.

AAPA discloses that the diffusion barrier layer is TiN but does not explicitly disclose wherein the diffusion barrier layer is LaN as recited in present claim 1.

Kirlin discloses a method for manufacturing a semiconductor device comprising the steps of: providing a semiconductor substrate (**FIG. 8: 102**); forming an interlayer insulating layer (**FIG. 8: 104**) on the semiconductor substrate; forming a contact hole in the interlayer insulating layer; forming a plug recessed (**FIG. 8: 106**) inside the contact hole; forming an ohmic contact layer (**FIG. 8: 107**) on the plug; depositing a layer of titanium aluminum nitride (**FIG. 8, 108**) or other suitable diffusion barrier layer material of construction (col. 5, lines 9-19) such as LaN (col. 6, lines 45-62) on the ohmic contact layer; and sequentially forming a bottom electrode (**FIG. 8: 110**), a high dielectric constant material (**FIG. 8: 112**) and a top electrode (**FIG. 8: 116**) on the entire structure. It would have been obvious to one of ordinary skill in the art of making semiconductor devices to combine the teaching of AAPA and Kirlin to enable the LaN diffusion barrier layer of AAPA to be formed and furthermore to reduce the possibility of diffusion of oxygen during subsequent processing steps (col. 6, lines 45-47).

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Neither AAPA nor Kirlin discloses wherein, in the BLT dielectric layer, the atomic concentration of Bi is 3.25 to 3.35 and the atomic concentration of La is 0.80 to 0.90 as recited in the currently amended claim 1.

Noh discloses, wherein in the BLT dielectric layer, the atomic concentration of Bi is 3.25 and the atomic concentration of La is 0.75 (col. 5-6, paragraphs [0035]-[0036]). Examiner interpret that the atomic concentration of La as disclosed by Noh is within standard deviation of applicant's claimed range of the atomic concentration of La, therefore would serve to reduce the fatigue of dielectric layer. It would have been obvious to one of ordinary skill in the art of making semiconductor devices to combine the teaching of AAPA, Kirlin and Noh to enable the BLT dielectric layer of AAPA to be formed and furthermore to improving fatigue behavior (col. 3, paragraph [0013]).

In re claims 2, 4, 5, 7, 9 and 10, examiner have not located evidence indicating that the thickness of the LaN diffusion barrier layer, the pressure, power and the temperature of the plasma treatment process, the atomic concentration of Bi in the BLT dielectric layer, the pressure and temperature of the plasma enhanced chemical vapor deposition process, and the speed and temperature of the thermal treatment process are critical and it has been held that it is not inventive to discover the optimum or workable ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen

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dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

In re claim 3, Kirlin discloses wherein the step of depositing the LaN diffusion barrier layer is performed by metal organic chemical vapor deposition (MOCVD) (col. 5, line 53 to col. 6, line 8).

In re claim 8, AAPA discloses wherein the MOD technique is carried out by steps including performing a first thermal treatment process for nucleation of the BLT layer and performing a second thermal treatment process for crystallization of the BLT layer (page 2, line 24 to page 3, line 4).

In re claims 6, 11 and 12, AAPA does not explicitly disclose wherein the top electrode is formed of a material selected from the group consisting of IrO<sub>2</sub>, Ru, Pt and RuO<sub>x</sub>, wherein x is an integer from 1 to 3.

Narwankar discloses wherein the top electrode is formed of Ru by a deposition technique selected from the group consisting of CVD and physical vapor deposition (PVD) (pages 8-9, paragraph [0107]). It would have been obvious to one of ordinary skill in the art of making semiconductor devices to combine the teaching of AAPA and Narwankar to enable the top electrode of AAPA to be formed.

In re claim 13, AAPA discloses wherein the bottom electrode (**FIG. 1, 15**) is formed as a flat type.

***Response to Amendment******Response to Arguments***

In response to applicant's argument that the prior art does not shown wherein, in the BLT dielectric layer, the atomic concentration of Bi is 3.25 to 3.35 and the atomic concentration of La is 0.80 to 0.90, examiner respectfully disagree, the newly found reference Noh (European Patent Application EP 1 035 590) discloses this limitation (Current Office Action, page 4, 2<sup>nd</sup> paragraph).

Applicant further argues that the cited references do not teach or even suggest that the La diffusion barrier, which is formed between the ohmic contact layer and the bottom electrode in the contact hole. However, as cited in Paper No. 6, page 3, 2<sup>nd</sup> paragraph, Kirlin does teach the La diffusion barrier layer (**FIG. 8: 108**), which is formed between the ohmic contact layer (FIG. 8: 107) and the bottom electrode (FIG. 8: 110). Thus, applicant's arguments are moot and the rejection is considered proper.

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D Nguyen whose telephone number is (703) 306-0210. The examiner can normally be reached on Monday-Friday (8:00 AM - 5:00 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746-9179 for regular communications and (703) 746-9179 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

K.N.  
November 26, 2003

  
W. DAVID COLEMAN  
PRIMARY EXAMINER